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Demographic Profile and Administrative Capacity of Forest Officers in the Implementation of the Biological Diversity Act, 2002: An Empirical Study

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Abstract: Successful Biodiversity Legislation will be largely dependent upon the Administrative Capacity and Demographic Composition of Frontline Enforcement Personnel. An Empirical Demographic Analysis of Forest Officers Involved in Biodiversity Governance in Dadra and Nagar Haveli, Daman, Diu, and Palghar Districts is Provided Herein. Data Collection Utilized Structured Questionnaires Completed by 60 Forest Officers in the Selected Regions and Analyzed Using Descriptive Statistical Tools in SPSS. The Analysis Examined Age Distribution, Gender Representation, Hierarchical Position, Years of Service, and District-Wide Deployment of Forest Officers. The Results Show a Relatively Balanced Age Distribution Between Early-Career and Mid-to-Late Career Officers, With a Dominant Presence of Younger Personnel with Fewer Than 10 Years of Service. The Administrative Structure of Forest Officers Also Shows an Intense Concentration of Mid-Level (Class II) Officers, While Senior-Level Representation Remains Minimal. The Gender Analysis Indicates a Significant Male Dominance Within the Forest Administration. The district-Wise Distribution Shows a Balancing Act of Representation Across the Selected Regions, but a Higher Concentration of Forest Officers Exists in Dadra and Nagar Haveli. These Demographic Patterns Have Important Implications for Policy Implementation, Training Requirements, and Institutional Effectiveness Under Biodiversity Conservation Frameworks. The Study Clearly Demonstrates the Need for Capacity Building, Gender Inclusivity, and Strengthening Strategic Leadership to Enhance Effective Biodiversity Governance.

Introduction

The success of biodiversity legislation will be greatly influenced by the ability of frontline employees who execute these laws on a day-to-day basis. There is extensive research that demonstrates the relationship between personnel levels, skill level, and deployments to management effectiveness of protected areas (Appleton et al., 2022), however, there is a major shortfall across the world regarding each of these factors. Furthermore, rangers and forest officers act as "petty environmental sovereigns," translating legislative requirements into daily policing activities that directly impact both conservation results and community relationships (Cinque et al., 2021; Massé, 2019).

The demographics of those who carry out enforcement activities including their age, seniority and sex can affect their priorities and methods of enforcement as well as their responsiveness to the public. Research conducted in forestry institutions indicates that gaps in diversity and unequal hierarchies can diminish public trust and the effectiveness of organizations when leadership positions are not reflective of a broader society (Korhonen et al., 2023; Westphal et al., 2022). In addition, representative bureaucracies within environmental agencies have been found to promote a fairer application of environmental policies among less affluent communities (Liang et al., 2020), indicating that the composition of an agency impacts who will benefit from its policies.

Of all demographic characteristics, gender has become one of the most important aspects of environmental governance. A number of studies show that increased involvement of women in decision-making structures for forest management leads to enhanced governance and, in many cases, improved conservation results (Agarwal,

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2009; Leisher et al., 2016). Similarly, systematic evidence reviews demonstrate that the use of mixed-gender resource management teams can improve decision making, compliance and accountability, even though the quantity of high-quality, quantitative studies is limited (Kilonzo et al., 2024; Leisher et al., 2015; Leisher et al., 2016).

In the context of global and regional data, the study of the demographic characteristics of forest officers in the Union Territory of Dadra & Nagar Haveli, Daman, Diu and Palghar will provide crucial information about whether the age structure of personnel, the rank distribution of personnel, the average years of experience of personnel, the gender balance of personnel and the geographical location of personnel are enabling or constraining effective biodiversity governance and where specific capacity building and inclusion initiatives should be focused.

The placement of this study within the larger body of evidence on staffing, diversity and gender in environmental agencies emphasizes the importance of understanding who frontline forest officers are and where and how they operate in order to improve biodiversity governance and implementation effectiveness.

Research Methodology

The current study uses a descriptive and empirical methodology to assess the demographic characteristics of forest officers who are responsible for governing biodiversity. A systematic approach was utilized to determine age, gender, hierarchical level, number of years of service, and district-level distribution of forest officers based on the primary data obtained through a structured survey.

Research Design

A descriptive research design was selected for this study due to its ability to provide an overview and analysis of the demographics of the forest officer population that exists today, with no manipulation of variables. This type of design is ideal for determining institutional composition and administrative capacity regarding biodiversity-related governance.

Sources of Data

Primary data was gathered by utilizing a structured survey (Part C) administered to forest officers. Secondary data, consisting of reports, documents, and other literature regarding government policies and published works, was utilized to understand the context and interpret the data obtained.

Study Area

The study was conducted across four regions:

1. Dadra and Nagar Haveli
2. Daman
3. Diu
4. Palghar District

These regions were selected due to their ecological significance and active forest administrative structures.

Sample Size and Sampling Technique

There was a total of sixty forest officers in the sample for this study. A purposive sampling technique was used to select the sample from which these sixty forest officers were chosen, so as to include officers at various levels of hierarchy and from all districts with roles in forest and biodiversity administration.

Data Collection Instrument

A structured questionnaire was used as the primary tool for collecting the data in this study. The questions in the questionnaire covered:

1. Age Group
2. Gender
3. Official Position/Class
4. Years of Service
5. District of Posting

The questionnaire was developed to provide clarity and simplicity, as well as to ensure it would meet the requirements of the research objectives.

Data Analysis Techniques

The data collected was entered into SPSS by coding and then analyzed using SPSS. The following statistical techniques were applied to the data:

a) Frequency analysis

b) Percentage analysis

The findings were presented in table format, as well as graphically, to assist with the ease of interpretation of the results.

Ethical Considerations

Respondent participation in the study was voluntary. Respondents were informed about the purpose of the study and their responses were kept confidential. Personal identifiers were not used in the data analysis or reporting.

2.8 Limitations of the Methodology

a) The study is limited by the sample size of sixty forest officers.

b) The analysis was limited to demographic variables and did not assess the performance outcome.

c) The study's findings are specific to the regions selected and cannot be generalized to other regions throughout Nigeria.

Results and Discussion

This section provides a comprehensive review of the demographic characteristics of the forest officers as determined by the data collected through Part C of the questionnaire. In addition to providing an overview of the

age of forest officers, the section also includes gender, level of hierarchy, years of service, and district-wise distribution of forest officers. Together, the five variables in this section represent the institutional capacity, administrative preparedness, and human resource composition of the forest officers engaged in biodiversity management.

Age-wise Distribution of Forest Officers

Table 1 illustrates the age-wise distribution of forest officers. The results indicate that 31 (52%) of the forest officers were between the ages of eighteen and thirty-five years old, while 29 (48%) of the forest officers were between the ages of thirty-six and sixty years old.

The fact that there is a nearly equal distribution among the two groups suggests that there is a balance between the number of younger, early-career forest officers and the number of older, mid- to late-career forest officers. Younger officers will most likely contribute operational efficiency, adaptability and technical expertise, while older officers will contribute experience, institutional memory, and strategic decision making capabilities. As such, having a balance in the age distribution of forest officers should be beneficial to implementing biodiversity related policies effectively. However, the success of this will depend on the development of formal mentoring programs to enable the sharing of information between the older and younger forest officers.

Table 1. Age-wise Distribution of Forest Officers.

Age Group (Years)	Frequency	Percentage (%)
18–35	31	52
36–60	29	48
Total	60	100

Figure 1. Age Groups of Forest Officers.

Gender-wise Distribution of Forest Officers

The distribution of Forest Officers by gender is depicted in Table 2 as predominantly male: 80% of all respondents are men (48), while 20% are women (12) out of 60 total respondents.

This data supports the notion that forest and environmental administration has historically been a male-dominated field. The low percentage of females within this administrative field will also likely have an impact on the inclusiveness of government and the variety of viewpoints that can be used to govern at the community level and to conserve traditional knowledge which is typically held by women. Increasing the number of women involved in the administration of forests should positively affect the participatory biodiversity governance and increase communication with the local community.

Table 2. Gender-wise Distribution of Forest Officers.

Gender	Frequency	Percentage (%)
Male	48	80
Female	12	20
Total	60	100

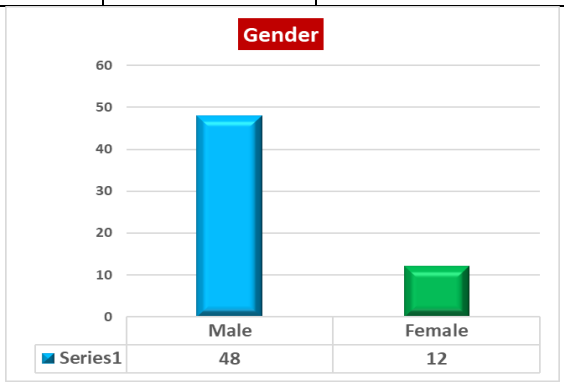

Figure 2. Genders of Forest Officers.

Position-wise Distribution of Forest Officers

As Table 3 indicates, most of the Respondents have been assigned jobs at class II level (39 Officers = 65 %), then at class III level (18 Officers = 30%), and there is only one (1.7%) class I Officer, while six (10%) class IV staff have been assigned to job positions. It is evident from the Data that an administrative hierarchy of the type of pyramid has developed within the organization which places middle management personnel as central players with respect to the day-to-day operational activities and for the implementation of policies and programs. This hierarchy provides an environment that allows the efficient and effective operation of activities at the field level; however, it limits senior-level personnel from providing strategic direction, interpreting policies, and coordinating between departments. Increasing the number of senior personnel will improve the ability of leadership and enable them to make decisions effectively.

Table 3. Position-wise Distribution of Forest Officers.

Position Category	Frequency	Percentage (%)
Class I	1	1.7
Class II	39	65.0
Class III	18	30.0
Class IV	6	10.0
Total	60	100

Years of Service of Forest Officers

Table 4 shows the service duration of the forest officers. Forty-seven percent of the respondents (28) indicated that they had 2 – 5 years of service as forest

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officers. The next highest category was 32% of the respondents (19), who had 6 – 10 years of experience. Ten percent (6) of the respondents had more than 10 years of experience, and 12 percent (7) were new hires with less than 1 year of service.

The data in Table 4 indicates that there is a high percentage of relatively young officers in the forest department. Young officers typically have an enthusiasm for their job and can be flexible and adaptable to new ideas and approaches. However, these same young officers may lack long-term experience to effectively perform certain administrative functions such as legal enforcement, the preservation of traditional knowledge, and inter-agency cooperation. Therefore, it will be necessary for the forest department to implement continuing education programs, capacity building, and experiential learning programs to enhance the administrative abilities of its employees.

Table 4. Years of Service of Forest Officers.

Years of Service	Frequency	Percentage (%)
0–1 Years	7	12
2–5 Years	28	47
6–10 Years	19	32
10 Years & Above	6	10
Total	60	100

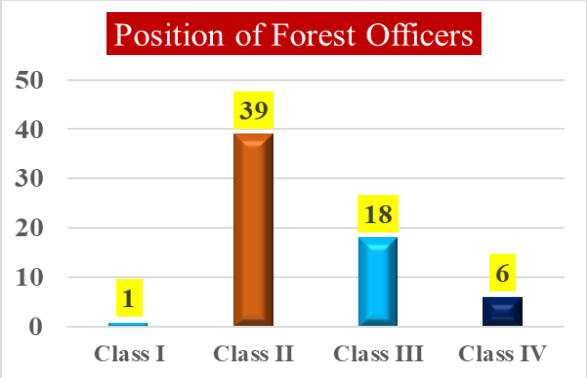

Figure 3. Position of Forest Authorities.

District-wise Distribution of Forest Officers

Forest Officer numbers are distributed as shown in Table 5 by district. Dadra and Nagar Haveli have the largest share (n = 19; 32%) of Forest Officers, while Palghar (n = 15; 25%), Daman (n = 14; 23%), and Diu (n = 12; 20%) are next.

The relatively even representation of districts in this data adds credibility and representativeness to the results of this study, but small disparities between districts can be due to variations in biodiversity intensity, administrative burden or local staffing policies. Areas with a greater environmental/conservation burden may require more administrators.

Table 5. District-wise Distribution of Forest Officers.

District	Frequency	Percentage (%)
Dadra and Nagar Haveli	19	32
Daman	14	23
Diu	312	20
Palghar	15	25
Total	**60**	**100**

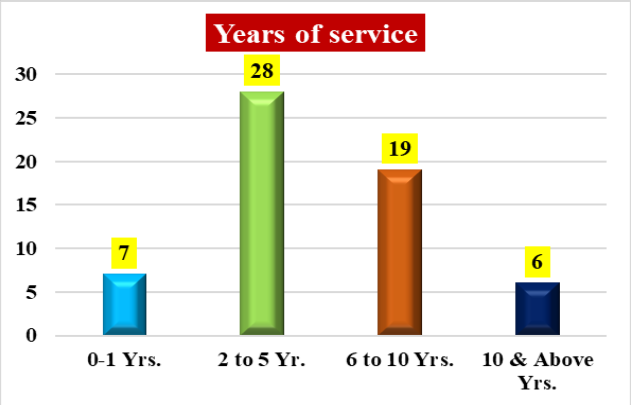

Figure 4. Number of Years of Service of Forest Officers.

Discussion and Conclusion

A general overview of the Demographics illustrates that the Forest Administration has an administration that is young, operationally focused, and regionally dispersed; however, it is also restricted by a significant gender imbalance and a lack of Senior Leadership Representation. A large number of Mid-Level Officers and relatively short service tenures illustrate the need for structured Capacity Building Initiatives, Leadership Development, and Policy-Oriented Training.

Strengthening gender disparities, increasing senior administrative positions, and expanding experiential learning opportunities will all have a substantial positive impact on institutional resilience, enforcement effectiveness, and the success of biodiversity governance.

This empirical investigation analyzed the demographic profile and administrative capability of forest officers involved in biodiversity governance in Dadra and Nagar Haveli, Daman, Diu, and Palghar districts, relative to the implementation environment for the Biological Diversity Act, 2002. The investigation used analysis of age structures, gender composition, hierarchical placement, years of service, and district-specific deployment to provide useful insight to the human resource foundations upon which frontline biodiversity governance occurs.

Results indicated a relatively balanced age structure among forest officers, suggesting the presence of both early-career and mid- to late-career officers within the forest administration. The presence of a balanced age structure offers several advantages including the ability of

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younger officers to be technologically adaptable and have flexibility to respond to new issues while older officers have experiential knowledge and institutional memory. However, the usefulness of the demographic mix of forest officers depends on the establishment of formalized mentorship systems and institutions that support the transfer of knowledge between generations of forest officers.

The investigation also highlighted a significant gender imbalance, with women being underrepresented in the forest administration. The results are consistent with existing literature and indicate that the gender disparity may limit inclusive governance, particularly in community participation and traditional knowledge conservation, where women often play essential roles. Therefore, addressing gender disparities through targeted recruitment, retention, and leadership development policies would likely increase inclusive and participatory biodiversity governance and conservation outcomes.

Hierarchical analysis found an overwhelming number of mid-level (Class II) officers and very few senior-level (Class I) officers in the administrative hierarchy, resulting in a pyramid-shaped structure. While this structure enables efficient day-to-day field-level operations, it limits the availability of senior-level leaders to develop policy, interpret laws, and facilitate coordination with other departments. Therefore, increasing the availability of senior-level leaders is necessary to improve the administrative efficiency of the forest administration.

Additionally, the service tenure data suggested a workforce primarily composed of early and mid-career professionals, representing a trend in recent hiring practices. While this trend creates energy and adaptability, it may limit the amount of long-term experience needed to perform complex tasks, such as enforcing laws related to access and benefit sharing, coordinating across government agencies, etc. As a result, continued professional development, capacity building and experiential learning will be key to increasing the institutional competency of the forest administration.

Finally, the relatively even distribution of forest officers across districts increases the study's representativeness and indicates that the forest administration has regionally distributed administrative coverage. However, the varying degrees of biodiversity intensity and conservation challenges across districts suggest the need for context-specific staffing and deployment strategies to address regional differences.

In conclusion, this study emphasizes that effective biodiversity governance depends not only on the legal frameworks governing biodiversity management but also on the demographic composition, experience profiles, and institutional positioning of the frontline forest officers implementing these legal frameworks. Increasing gender diversity, increasing the availability of senior leaders, and developing and sustaining capacity-building initiatives will all contribute to improved administrative preparedness, enforcement effectiveness, and long-term biodiversity conservation outcomes. Future studies could build on this body of research by examining the relationship between demographic characteristics and performance measures and/or conservation outcomes to guide evidence-based policy and administrative reform.

Conflict of interest

None

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